Space Weather Technical Forecast

Issued on Saturday, 20 November 2021 at 12:37 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor geomagnetic storms days 1 and 2 (20th and 21st).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the last 24 hours, with no significant X-ray flare activity observed at GOES 16. There are two active sunspot regions on the visible disc: AR2896 and AR2897, which are both small and stable unipolar Hsx/Alpha regions.
No Earth-directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, started the period at slightly elevated levels, around 450 km/s, then gradually declined to near 400 km/s before increasing from 20/0500 UTC to around 550 km/s. This is likely due to the earlier than expected to the high speed stream from coronal hole 20. The solar wind density was predominantly at average levels for most of the period before dropping below average late in the period. The IMF Bt was weak with brief interludes into moderate levels reaching 10nT at 20/0612 UTC. There were only weak deflections of +5/-5 nT in the Bz. The phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained at Background levels. The high energy electron flux (greater than 2 MeV) was predominantly at Moderate levels, peaking at 643 pfu at 19/2020 UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a slow rising trend, reaching 1.87e7 integrated pfu at 20/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with a Slight Chance of C-class flares.
Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the current forecast. Earth appears to have connected to the negative coronal hole 20 high speed stream. Geomagnetic activity is expected to increase to predominantly Unsettled to Active (Kp 3-4) with a chance of isolated G1/Minor (Kp 5) geomagnetic storms. Similar conditions are likely to start day 2 (21st) with coronal hole effects then expected to gradually ease through days 3 and 4 (22nd and 23rd), bringing an eventual return to mainly Quiet conditions by the end of the period.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels.
The high energy electron flux (greater than 2 MeV) is expected to rise under HSS influence. This brings an increasing chance of reaching the High threshold (1000 pfu) from day 2 (21st).The corresponding fluence is likely to have an increasing trend through the period, with an increasing chance of reaching the Active (1e8 integrated flux), on days 3 and 4 (22nd and 23rd).

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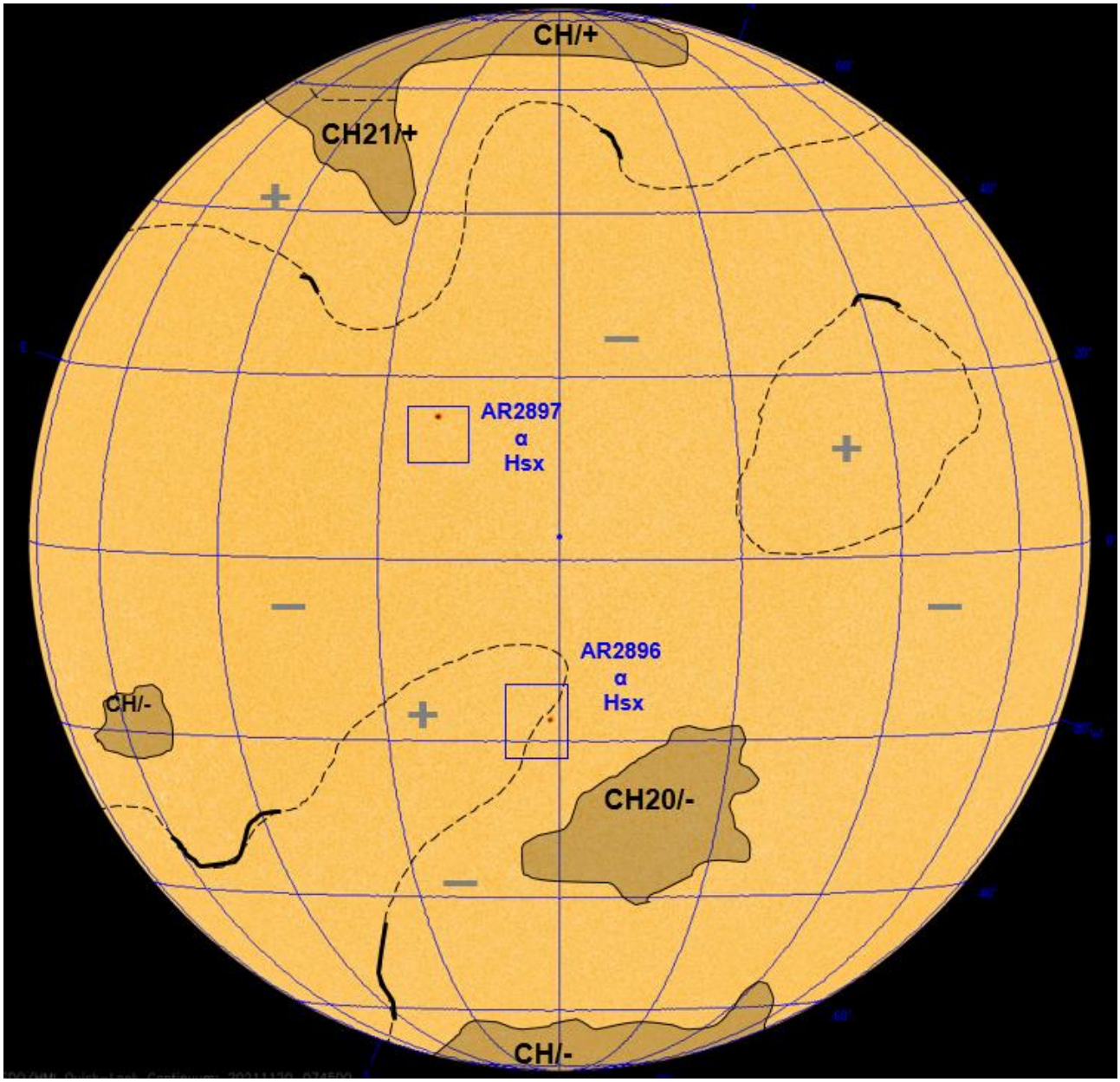
Figure 1. Solar Analysis Valid 20/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

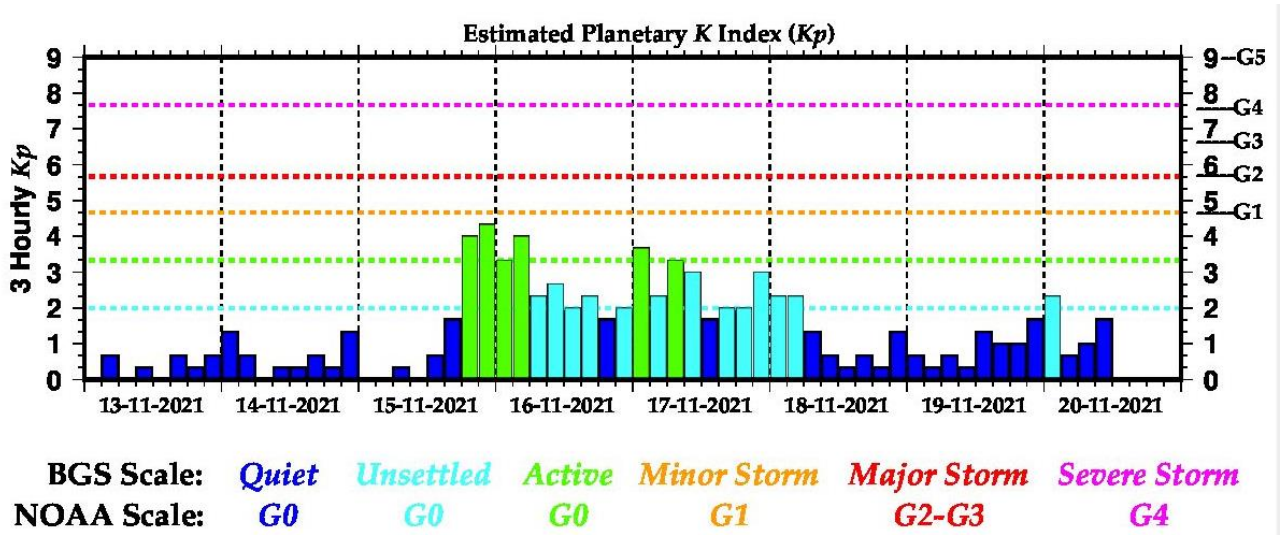
There are no Earth-directed CMEs that feature in the current forecast.
The HSS from CH20 may have arrived earlier than expected. Looking at the STEREO A data, strong speeds between 600-750 km/s are possible. Therefore, despite approaching the semi-annual minimum in coronal hole potency, there remains a Chance of G1, possibly peaking as the feature matures into day 2 (21st).

Geomagnetic activity is expected to increase to predominantly Unsettled to Active (Kp 3-4) later on day 1 (20th), with a chance of isolated G1/Minor (Kp 5) geomagnetic storms. Similar conditions are likely to start day 2 (21st) with coronal hole effects then expected to gradually ease through days 3 and 4 (22nd and 23rd), bringing an eventual return to mainly Quiet conditions by the end of the period.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	50	50	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections- Nil

Figure 2:Estimated Planetary K Index (Kp) from BGS


Estimated Planetary K Index (Kp)
3 Hourly Kp
9 8 7 6 5 4 3 2 1 0
G5 G4 G3 G2 G1
13-11-2021 14-11-2021 15-11-2021 16-11-2021 17-11-2021 18-11-2021 19-11-2021 20-11-2021
BGS Scale: Quiet Unsettled Active Minor Storm Major Storm Severe Storm
NOAA Scale: G0 G0 G0 G1 G2-G3 G4

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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

There are currently two active sunspot regions on the visible disc; AR2896 and AR2897. Both are simple, stable and unipolar spots.
Neither region will rotate off the visible disc during the forecast period. STEREO A EUVI imagery does not indicate that any significant regions will arrive from the farside through the period.
Therefore Very Low solar activity is forecast, with a slight chance (10%) of C-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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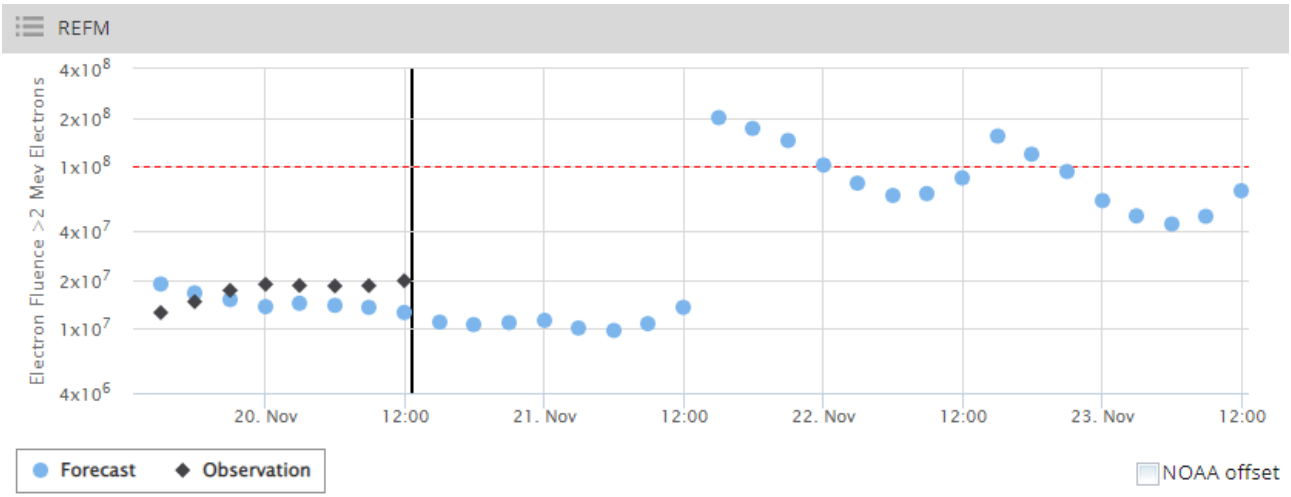
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2 MeV) has been at mainly moderate levels. The onset of CH20/- is likely to temporarily suppress flux levels before they then begin to rise under HSS influence. This brings an increasing chance of reaching the High threshold (1000 pfu) from day 2 (21st).
The corresponding fluence is likely to have an increasing trend through the period, with an increasing chance of reaching the Active (1e8 integrated flux), on days 3 and 4 (22nd and 23rd). The Met Office REFM model shows the fluence following an upward trend, eventually breaching the Active threshold. The overall trend is considered good guidance, however there is uncertainty regarding precisely when Active fluence may be reached, this is more likely as the period progresses once HSS has been established.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	30	50	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	5	5

Figure 3: MOSWOC REF Model.



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